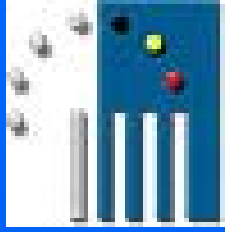

Biogeochemistry of Coccolithophore Blooms along the Continental Margin of the Northern Bay of Biscay

Lei CHOU

Laboratoire d'Océanographie Chimique et Géochimie des Eaux

Université Libre de Bruxelles

Eur-Oceans Final Meeting, Rome, 25-27 November 2008

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Anja Engel, Judith Piontek, Nicole Händel
HGF-Young Investigators Group

Steve Groom
Remote Sensing Group

Sabine Schmidt
Environnements et Paléoenvironnements Océaniques

The PEACE Project

Objectives:

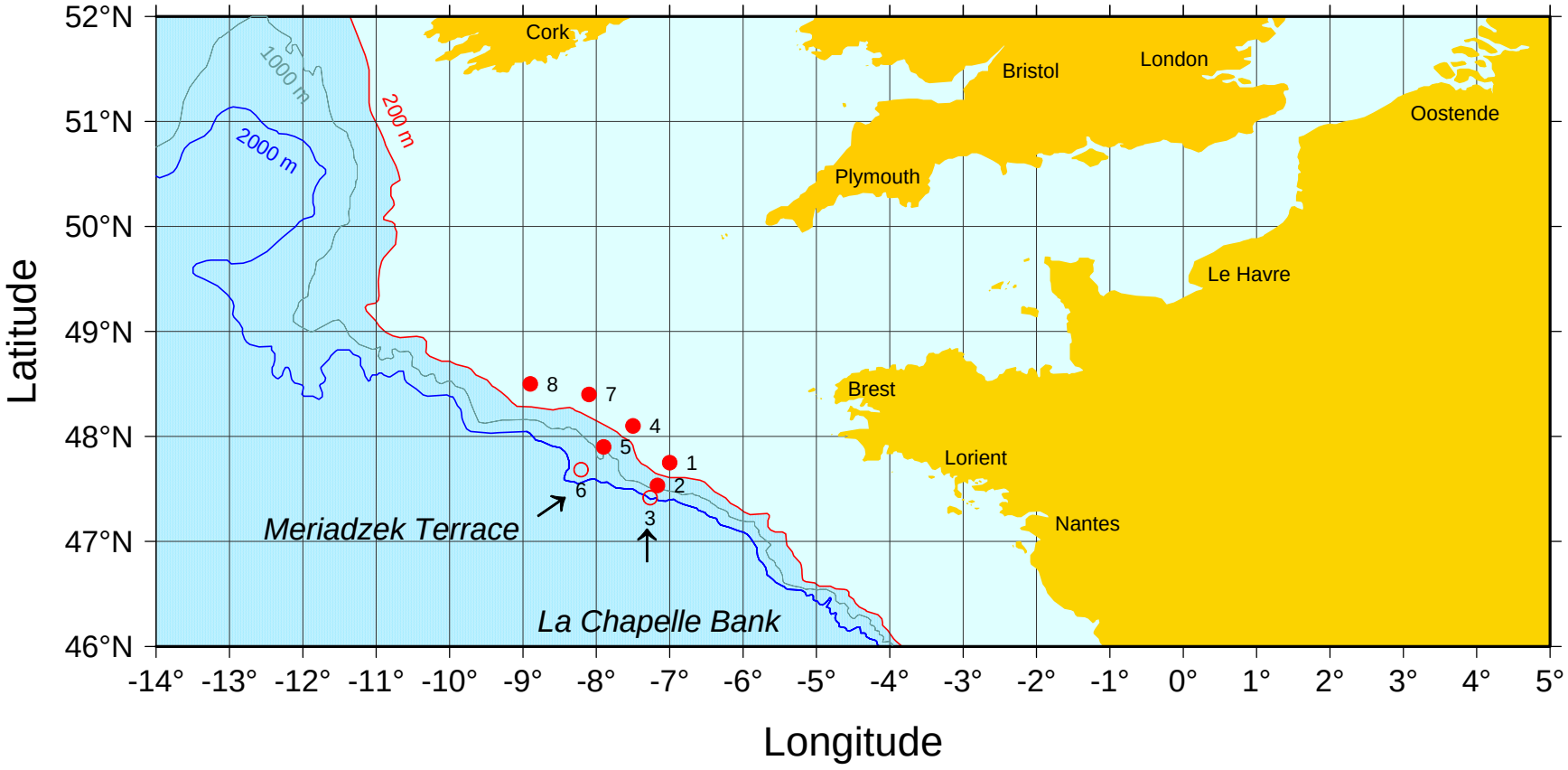
To evaluate the role in climate regulation of calcification, primary production and export processes during blooms of coccolithophores, an important group of calcifying phytoplankton.

Methodology:

To apply a transdisciplinary approach that combines process-oriented field investigations with laboratory experiments and modelling tools.

BELGICA BG2006/11 CRUISE

29 May – 10 June 2006

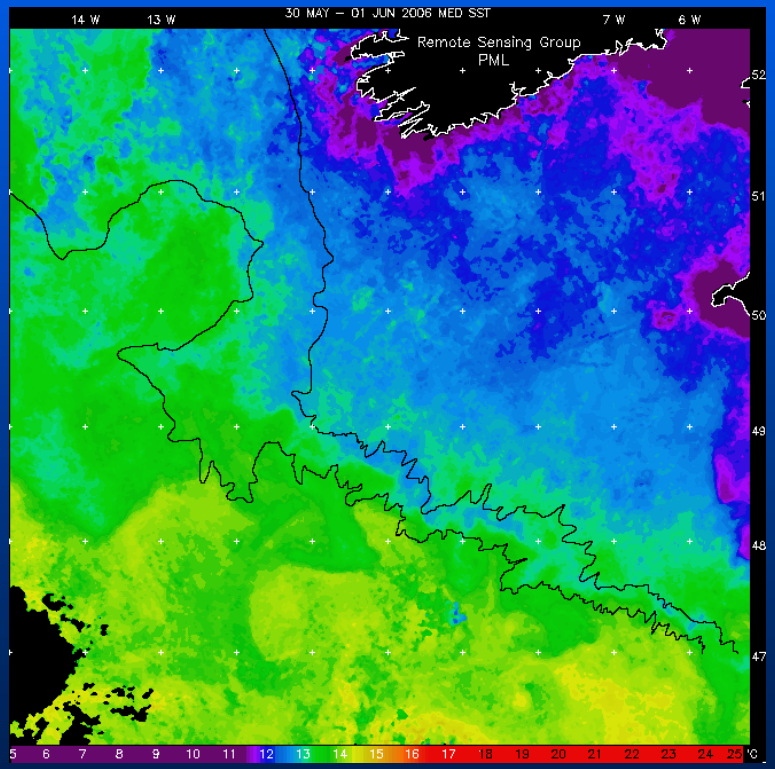


● Process-studies stations including CTD & water samples

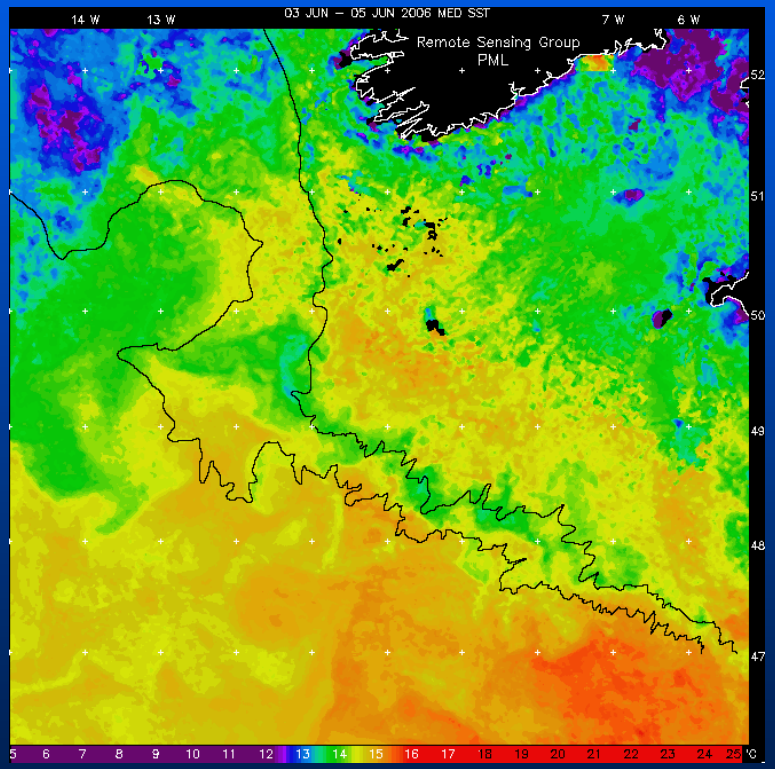
○ CTD + Water Samples

Sea Surface Temperature

30 May – 01 June 06



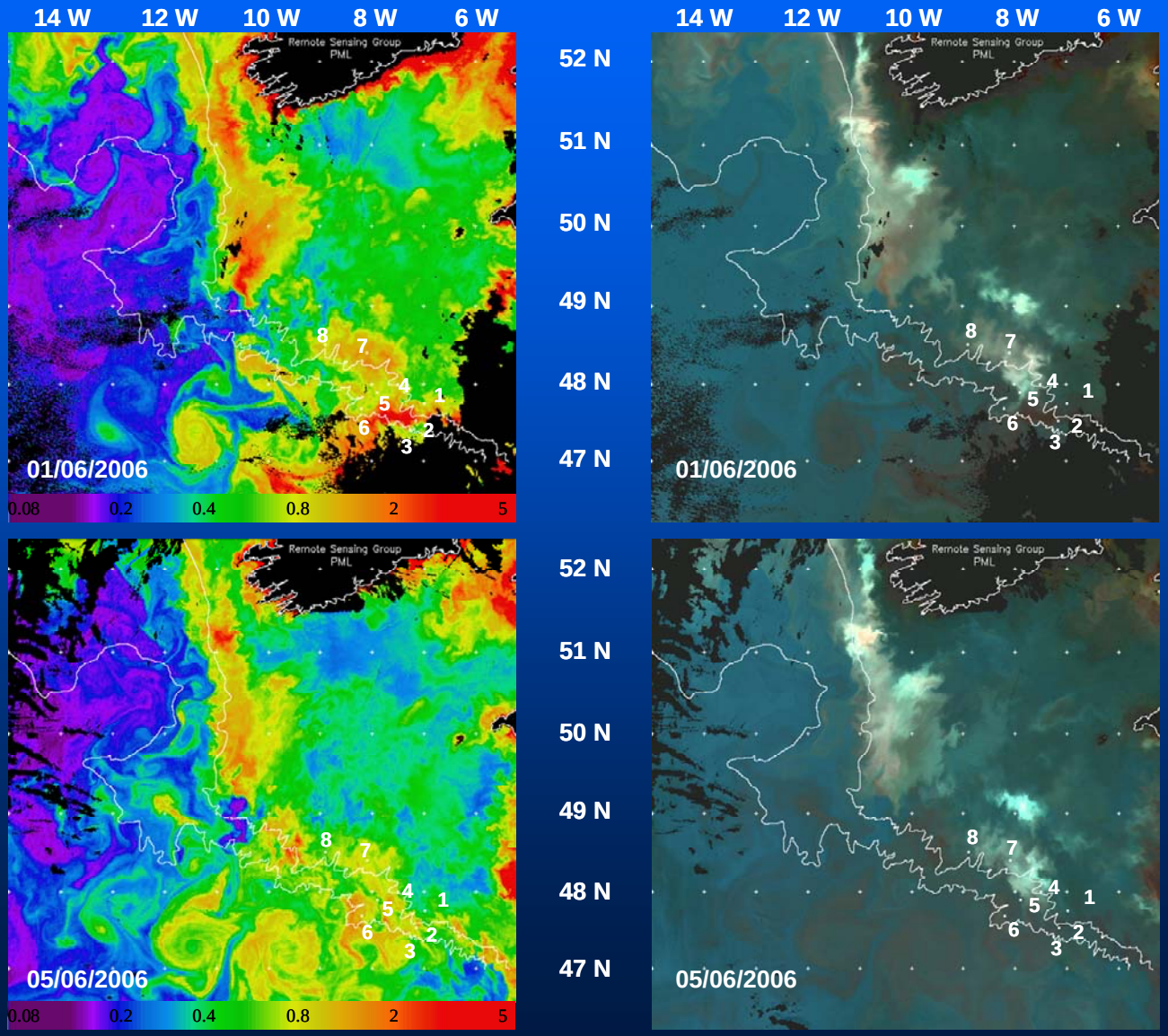
03 -05 June 06



PML

Chlorophyll

Reflectance



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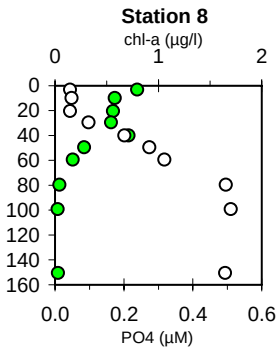
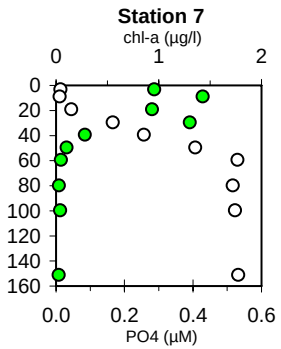
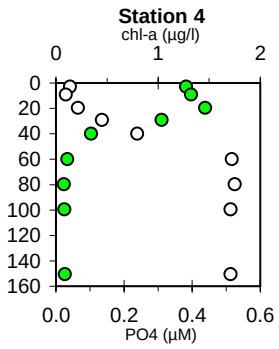
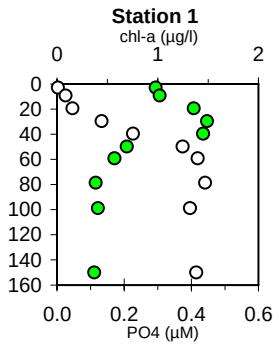
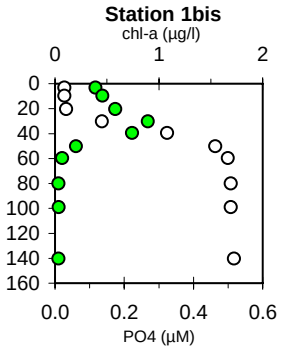
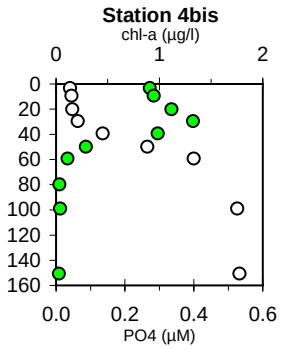

Station 8
chl-a (µg/l)
PO4 (µM)

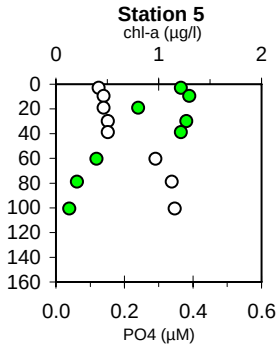

Station 7
chl-a (µg/l)
PO4 (µM)

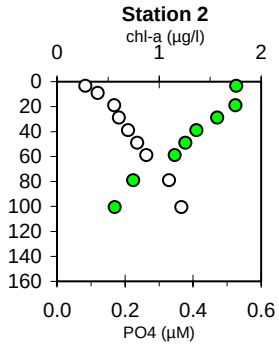

Station 4
chl-a (µg/l)
PO4 (µM)

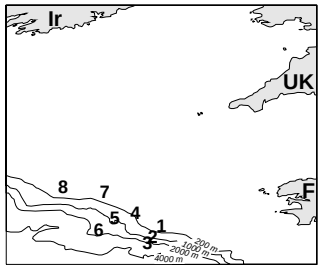

Station 1
chl-a (µg/l)
PO4 (µM)

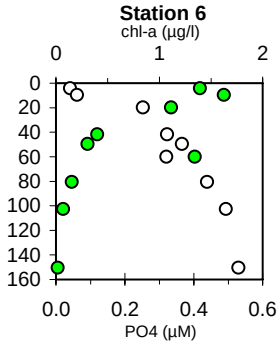

Station 1bis
chl-a (µg/l)
PO4 (µM)

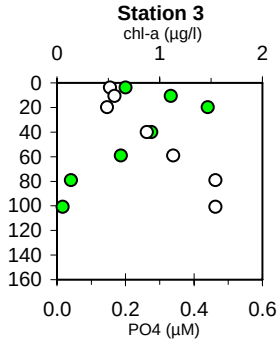

Station 4bis
chl-a (µg/l)
PO4 (µM)

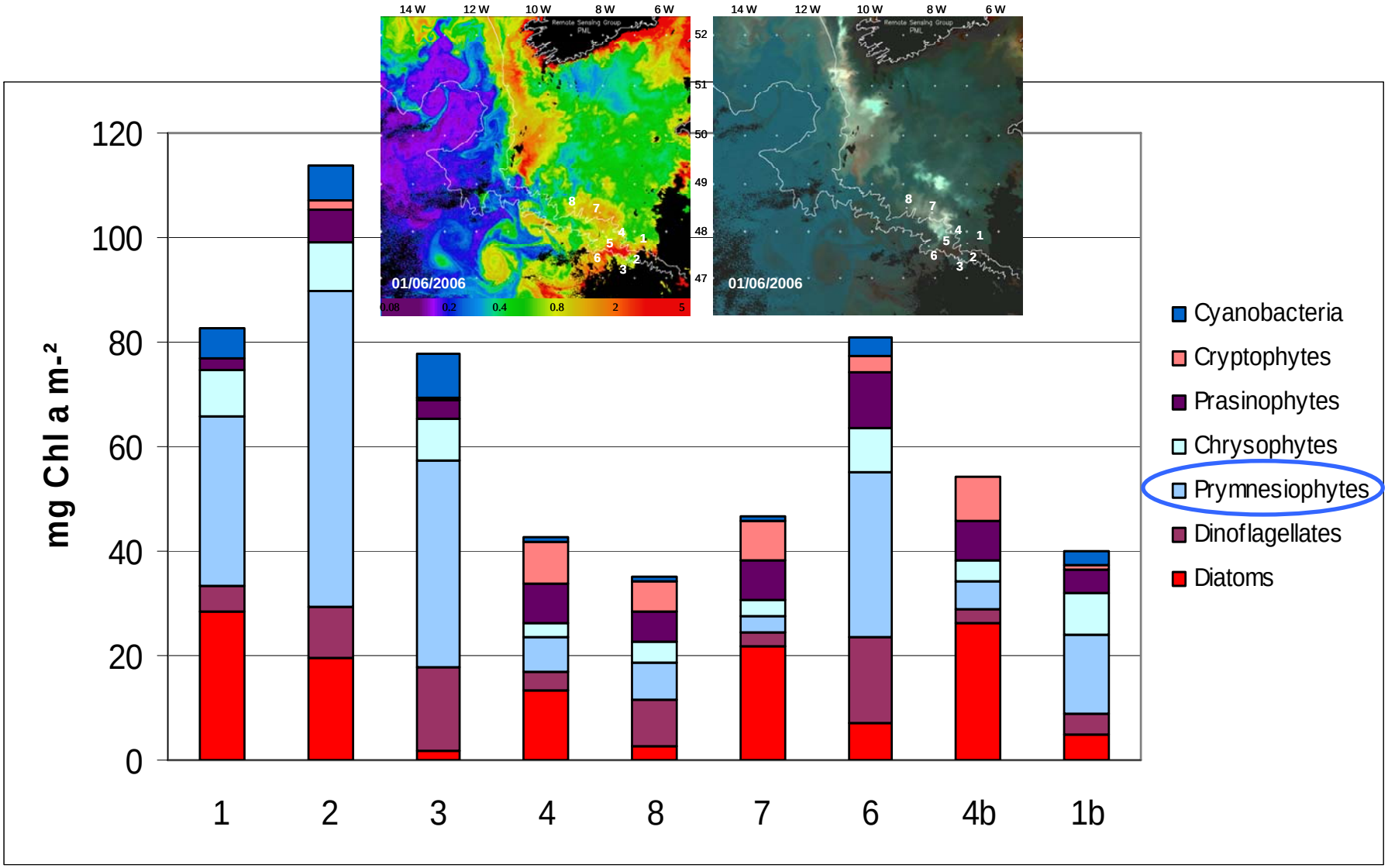

Station 5
chl-a (µg/l)
PO4 (µM)

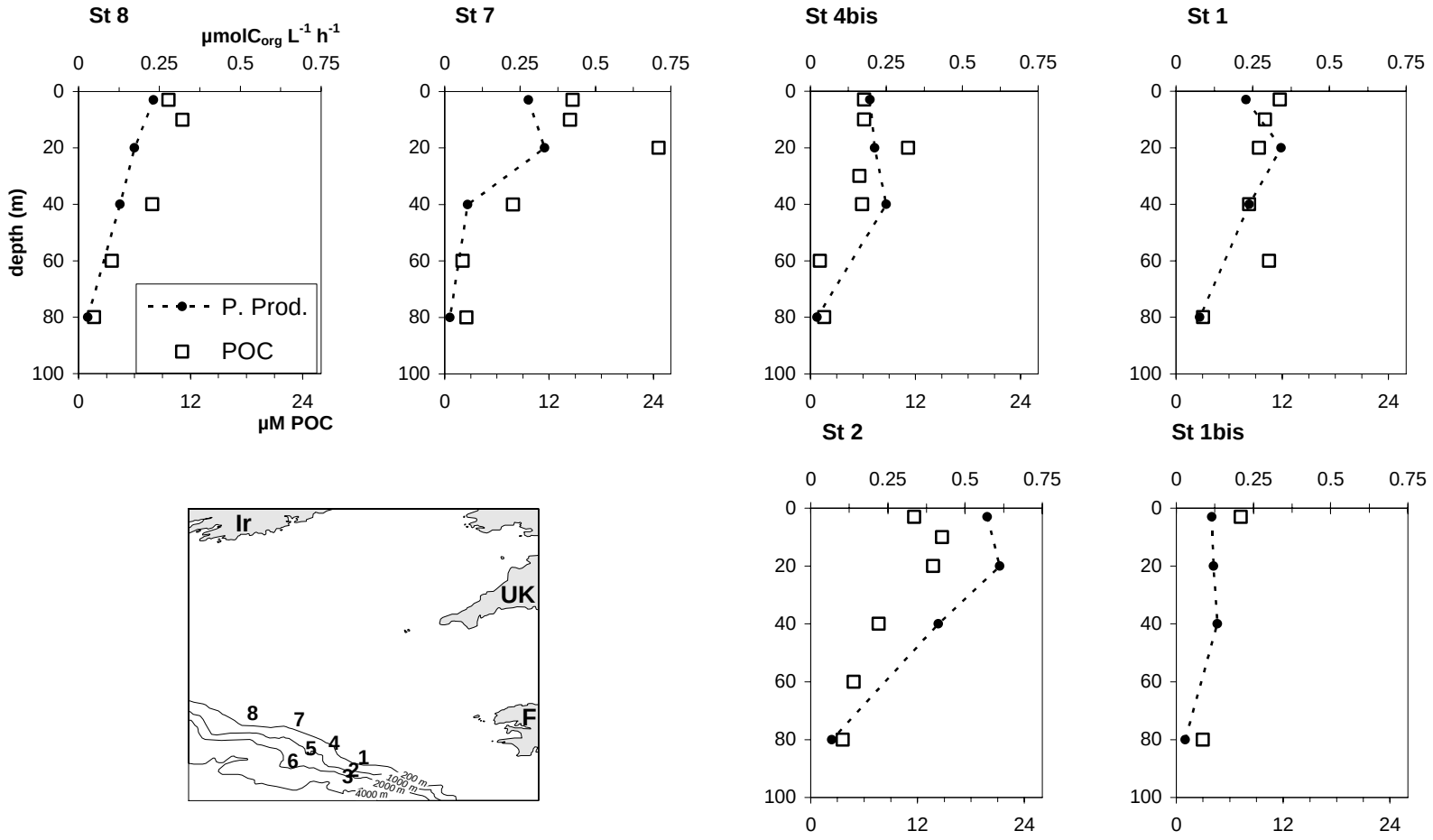

Station 2
chl-a (µg/l)
PO4 (µM)

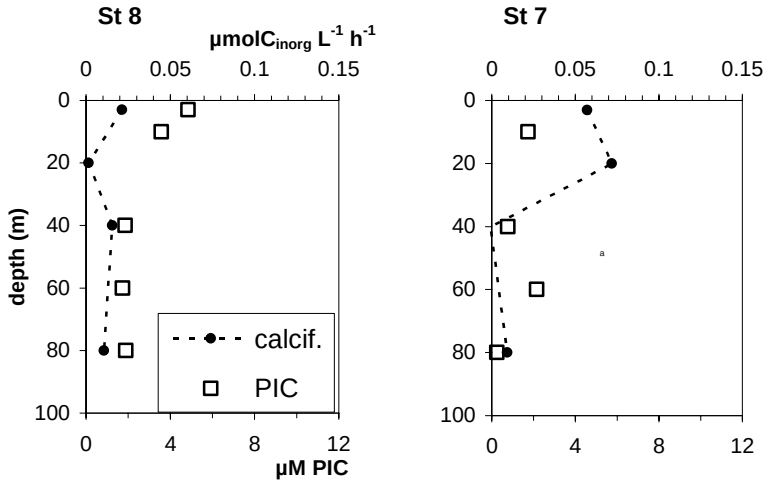

Ir
UK
F
8
7
4
5
1
6
3
200 m
1000 m
2000 m
4000 m


Station 6
chl-a (µg/l)
PO4 (µM)

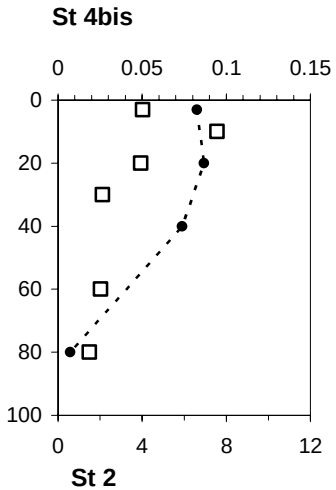

Station 3
chl-a (µg/l)
PO4 (µM)

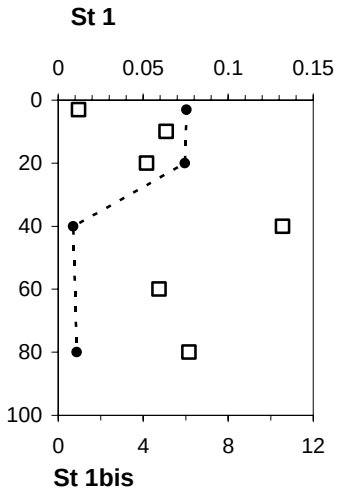

14 W
12 W
10 W
8 W
6 W
52
51
50
49
48
47
01/06/2006
0.08
0.2
0.4
0.8
2
5
8
7
4
1
5
6
2
3
01/06/2006
mg Chl a m-2
120
100
80
60
40
20
0
1
2
3
4
8
7
6
4b
1b
Cyanobacteria
Cryptophytes
Prasinophytes
Chrysophytes
Prymnesiophytes
Dinoflagellates
Diatoms

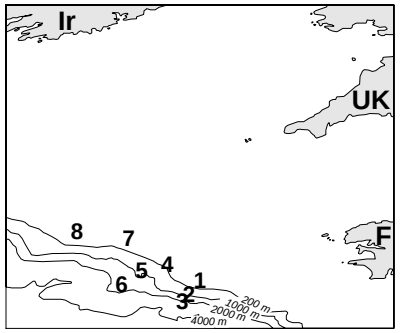

St 8
µmolC$_{org}$ L^{-1} h^{-1}
depth (m)
P. Prod.
POC
µM POC
St 7
St 4bis
St 1
St 2
St 1bis
Ir
UK
F
8
7
6
5
4
3
2
1
200 m
1000 m
2000 m
4000 m


St 8
µmolC$_{inorg}$ L^{-1} h^{-1}
0 0.05 0.1 0.15
depth (m)
0 20 40 60 80 100
0 4 8 12
µM PIC
calcif.
PIC

St 7
0 0.05 0.1 0.15
0 20 40 60 80 100
0 4 8 12


St 4bis
0 0.05 0.1 0.15
0 20 40 60 80 100
0 4 8 12


St 1
0 0.05 0.1 0.15
0 20 40 60 80 100
0 4 8 12


Ir
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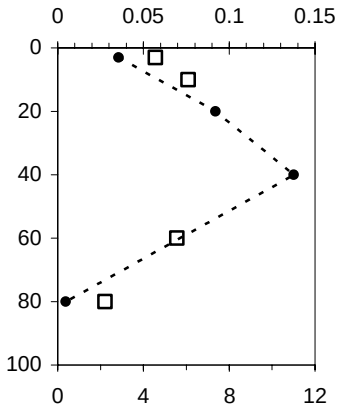
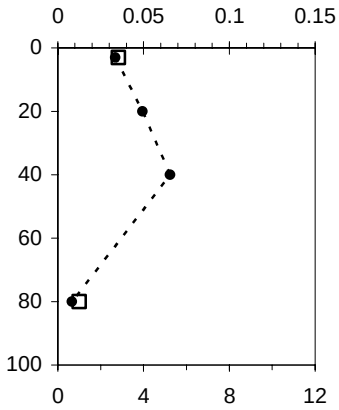
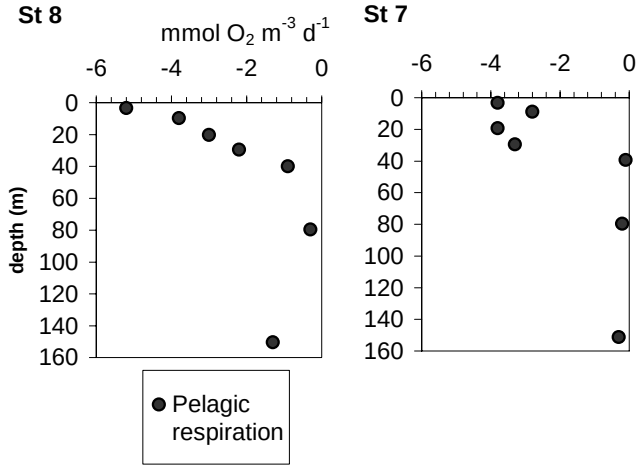
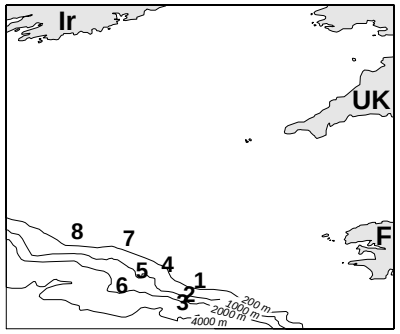
200 m
1000 m
2000 m
4000 m


St 2
0 0.05 0.1 0.15
0 20 40 60 80 100
0 4 8 12


St 1bis
0 0.05 0.1 0.15
0 20 40 60 80 100
0 4 8 12


St 8
mmol O_2 m^{-3} d^{-1}
depth (m)
-6 -4 -2 0
0 20 40 60 80 100 120 140 160
St 7
Pelagic respiration


Ir
UK
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7
5
4
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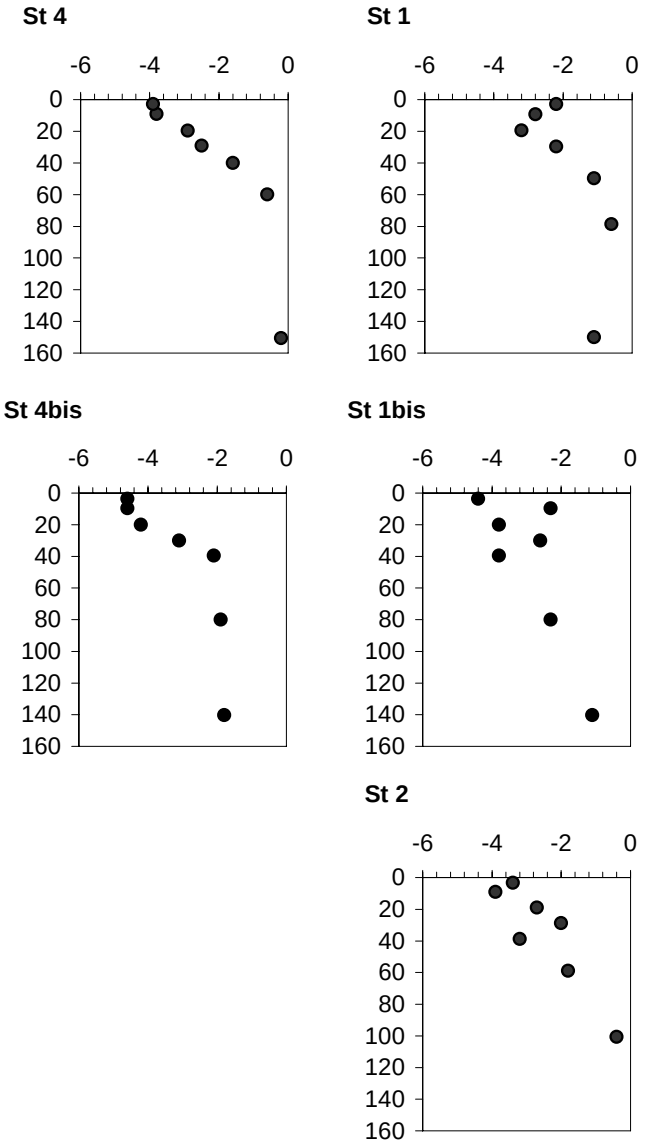
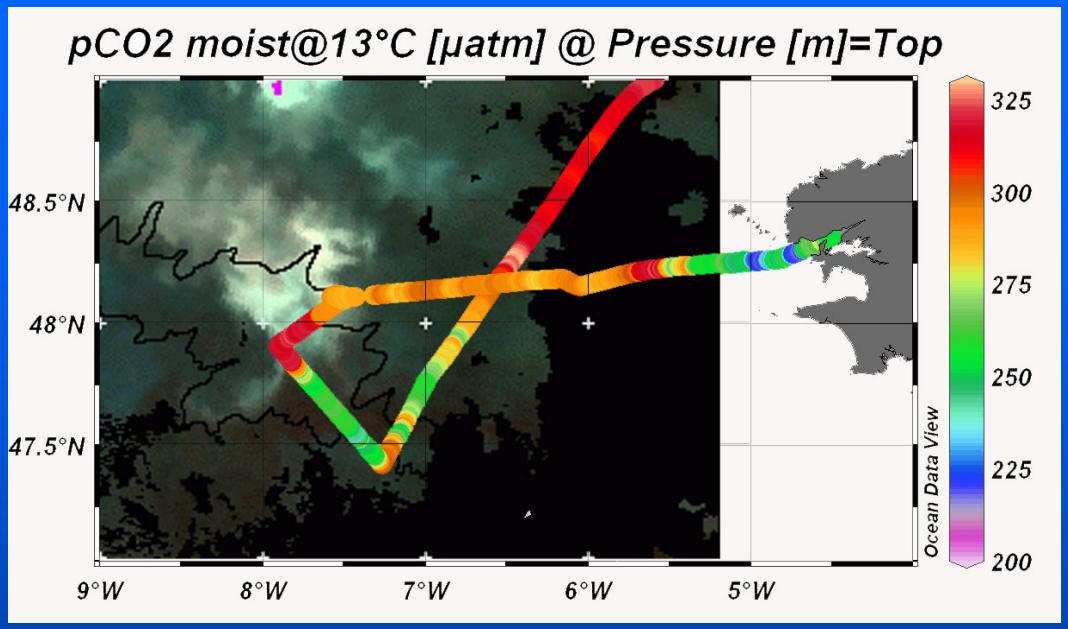
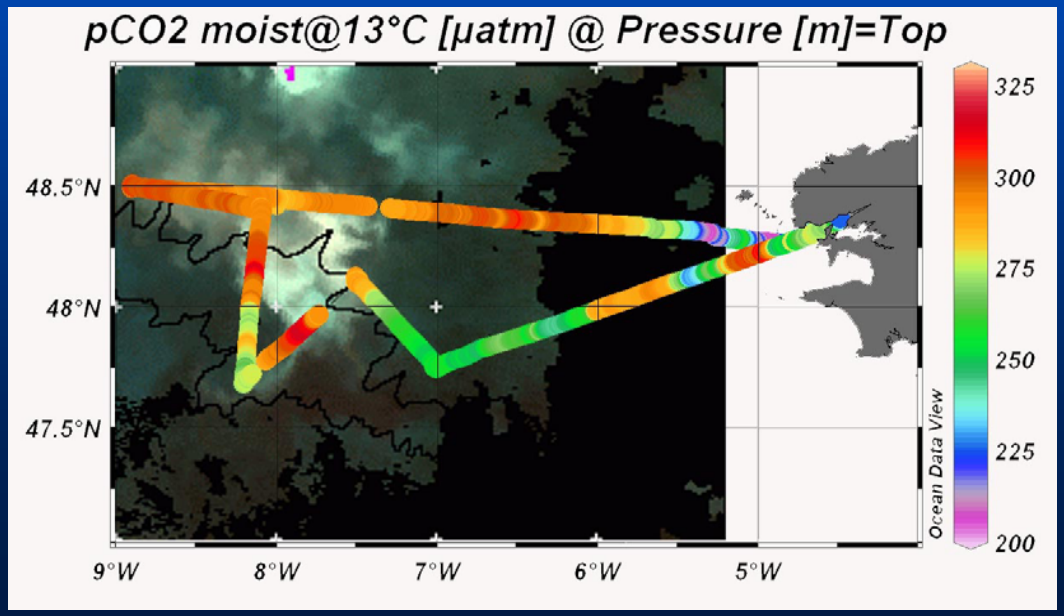
3
2
1
300 m
1000 m
2000 m
4000 m


St 4
St 1
St 4bis
St 1bis
St 2
-6 -4 -2 0
0 20 40 60 80 100 120 140 160

ULg



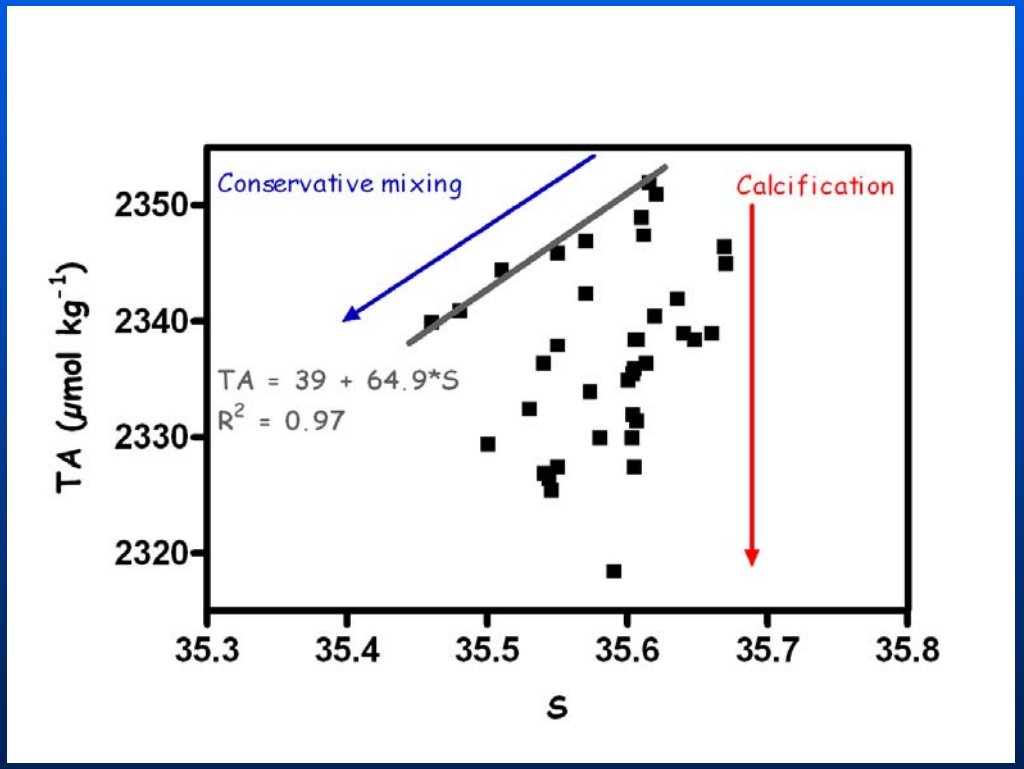
1st Leg
29 May – 3 June

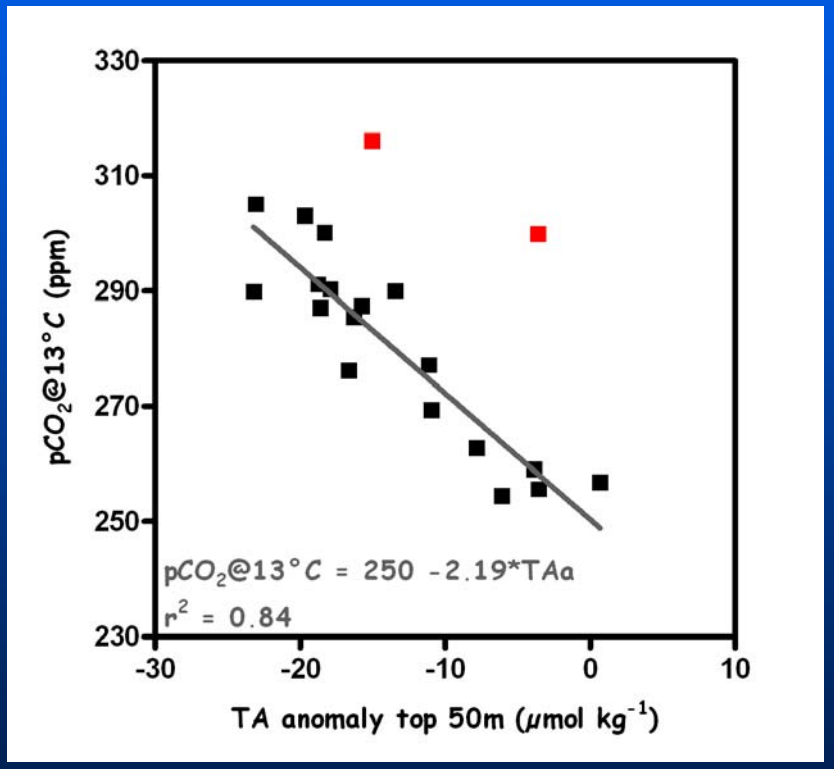


2nd Leg
5 – 10 June

ULg

$$Ca^{2+} + 2HCO_3^- \Leftrightarrow CaCO_3 + H_2O + CO_2\uparrow$$





ULg

C fluxes in mmol C m^{-2} d^{-1}

					Rate measurements			CO_2 Fluxes					C fluxes	
Station	Date	Total depth (m)	Photic depth (m)	pCO_2	GPP_p	CAL	PCR	GPP_p	CAL	PCR	Net CO_2 flux based on metabolic rates	Net CO_2 flux based on measured pCO_2	Export	Aphotic C demand
5	02-juin	500	26	320	74.2	24.2	-	-74.2	14.5	-	-	-9.1	-	-
2	01-juin	558	31	306	130.8	51.7	81.3	-130.8	31.0	81.3	-18.5	-11.4	49.5	89.0
1	31-mai	157	30	265	74.2	7.5	73.7	-74.2	4.5	73.7	4.0	-17.8	0.5	98.2
4 (HR)	02-juin	163	26	293	43.3	13.3	78.9	-43.3	8.0	78.9	43.6	-13.4	-35.6	66.9
1bis	09-juin	158	37	273	43.3	15.8	103.5	-43.3	9.5	103.5	69.7	-16.1	-60.2	159.0
4bis (HR)	08-juin	159	27	307	41.7	12.5	101.2	-41.7	7.5	101.2	67.0	-10.7	-59.5	168.5
7 (HR)	07-juin	164	26	309	71.7	28.3	81.4	-71.7	17.0	81.4	26.7	-10.2	-9.7	35.1
8 (HR)	06-juin	178	34	325	25.0	13.3	104.3	-25.0	8.0	104.3	87.3	-8.5	-79.3	72.3

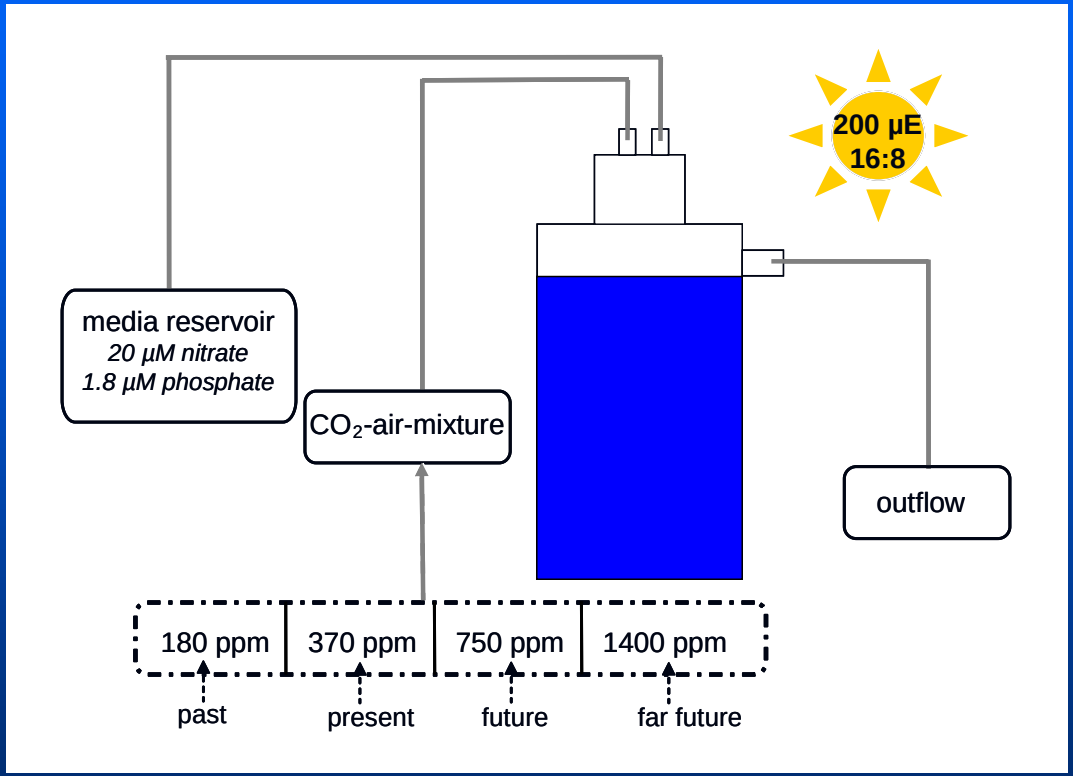
Harley et al.
(in preparation)

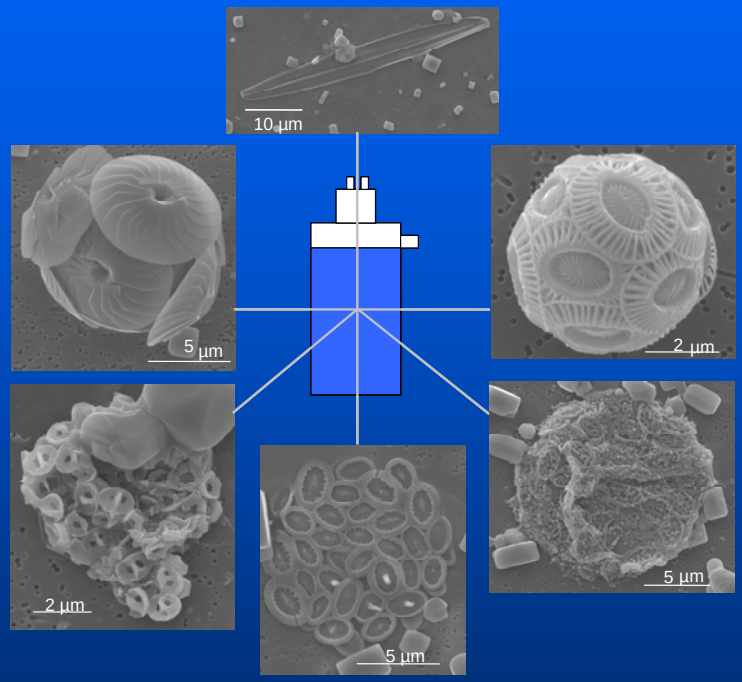
Positive CO_2 flux : ↑

Negative CO_2 flux : ↓

Export = GPP_p - PCR

Effect of CO_2 on Natural Plankton Community



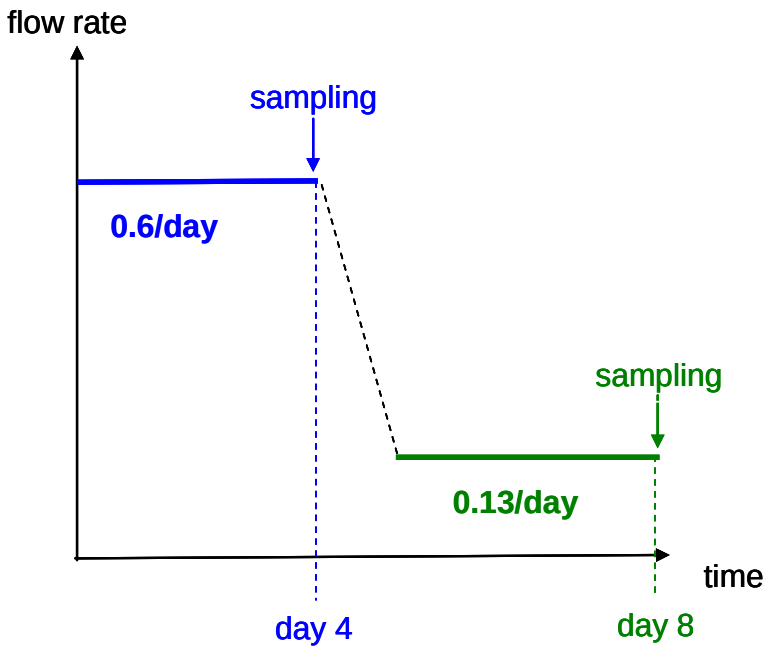


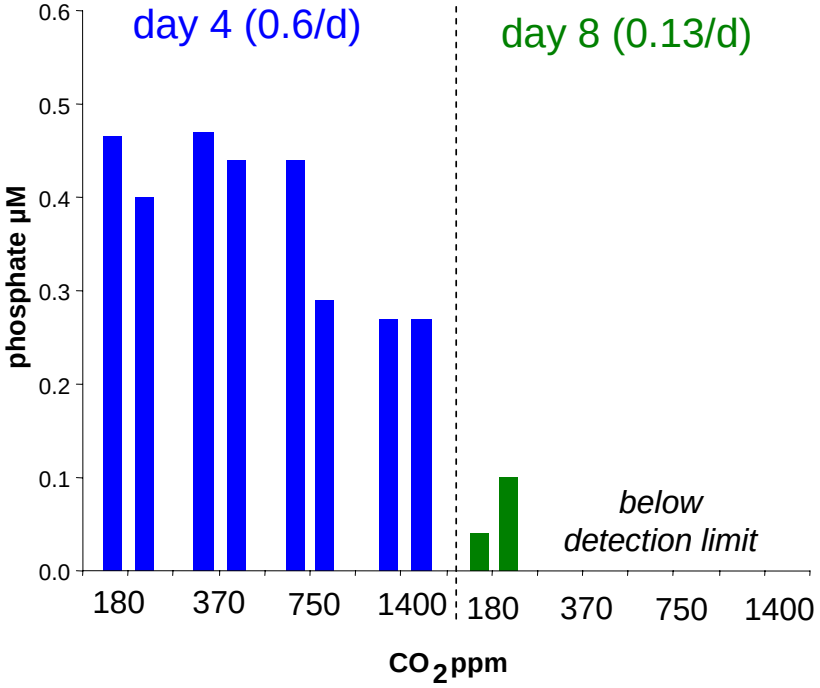
Station 2

AWI

Effect of CO_2 on Natural Plankton Community

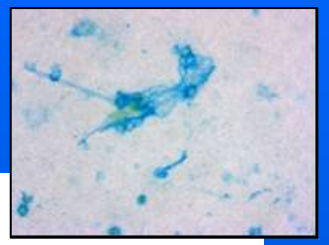
flow rates and nutrients

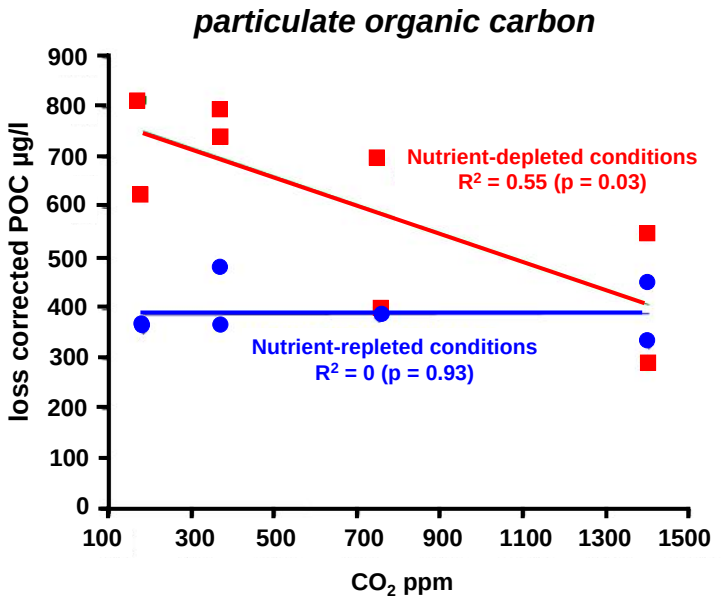


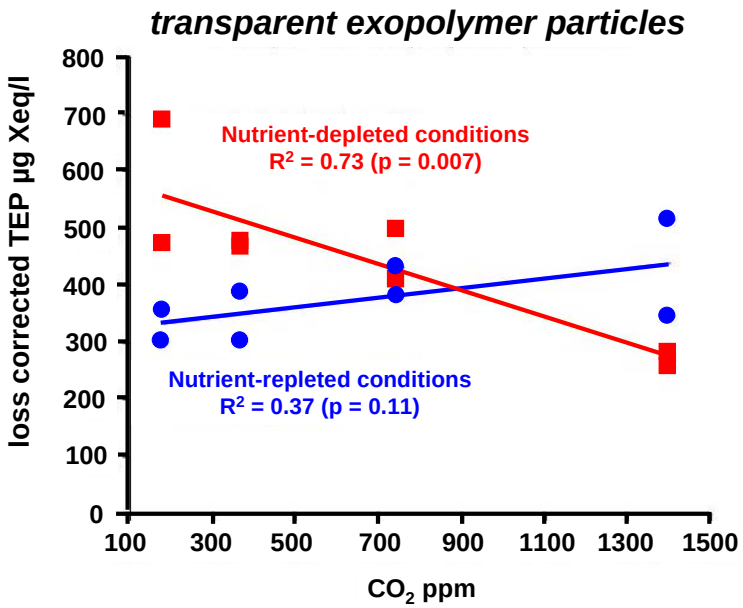


AWI

Effect of CO_2 on Natural Plankton Community



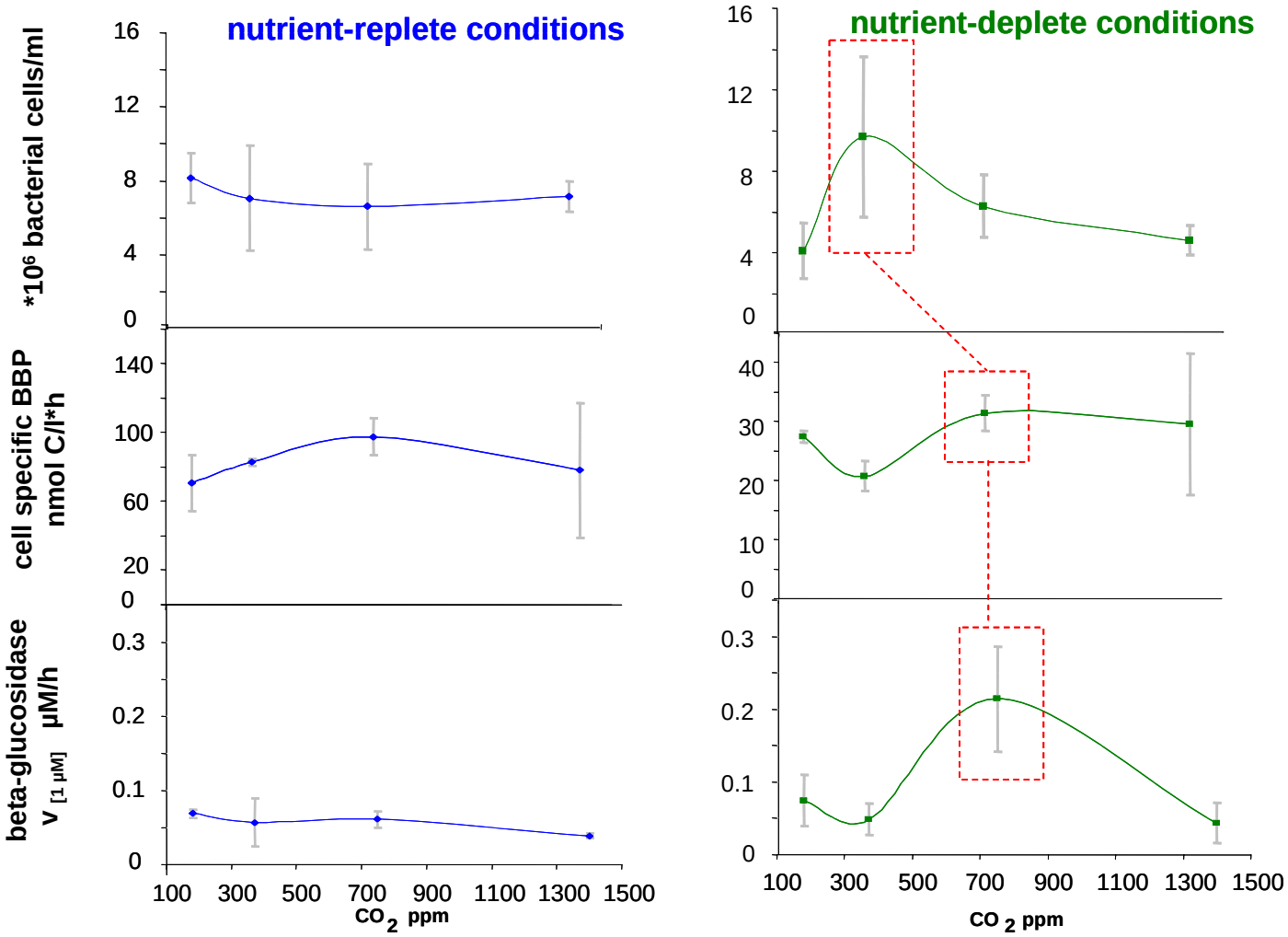




AWI

Effect of CO_2 on Natural Plankton Community

HETEROTROPHIC BIOLOGY

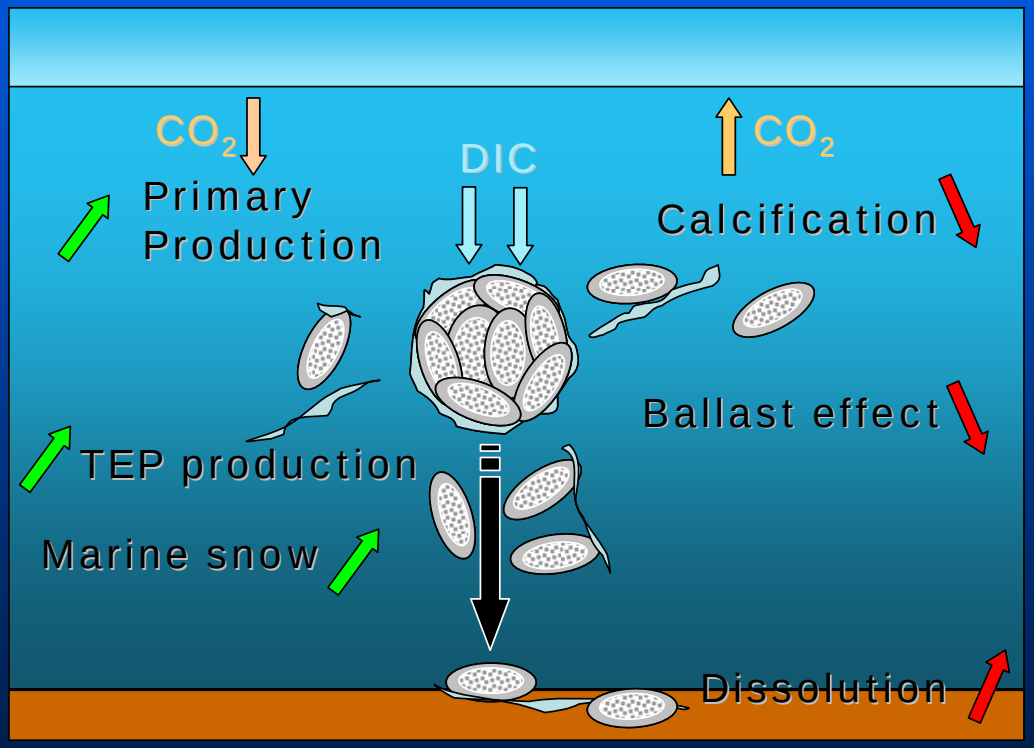


AWI

Possible feedback mechanisms in response to increasing ocean acidicifation

C-overproduction feedback

Calcification feedback



Rain ratio PIC:POC ↓
Dissolution of carbonate ↑

→ Negative feedback

Ballast effect ↓
TEP ↑ or ↓
Microbial activity ↑

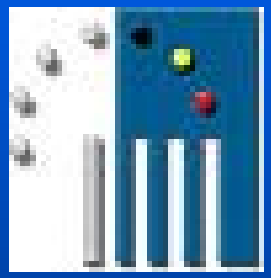
→ Overall Export of C ↑ ? ↓ ?

Other feedbacks ??

Combined effect ??

Thank you for your attention.

ACKNOWLEDGEMENTS



Belgian Federal Science Policy Office

Oceans

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